CLAIMS:

1. A precipitation-hardened stainless steel alloy consisting essentially of, by weight:

14.0 to 16.0 percent chromium;

6.0 to 7.0 percent nickel;

1.25 to 1.75 percent copper;

0.5 to 1.0 percent molybdenum;

0.03 to 0.5 percent carbon;

niobium in an amount by weight of ten to twenty times greater than carbon;

not greater than 1.0 percent manganese;

not greater than 1.0 percent silicon;

not greater than 0.1 percent vanadium;

not greater than 0.1 percent tin;

not greater than 0.030 percent nitrogen;

not greater than 0.020 percent phosphorus;

not greater than 0.025 percent aluminum;

not greater than 0.008 percent sulfur;

not greater than 0.005 percent silver;

not greater than 0.005 percent lead;

the balance being essentially iron;

wherein the alloy has a grain size of ASTM 5 or finer, a delta ferrite content of less than 0.5 weight percent, an ultimate tensile strength of at least 1200 MPa, a Charpy impact toughness of greater than 55 J, and is tempered at a temperature of about 480°C to about 525°C.

2. A precipitation-hardened stainless steel alloy according to claim 1, wherein the steel alloy has a Charpy impact toughness of at least 80 J.

3. A precipitation-hardened stainless steel alloy according to claim 1, wherein the alloy contains niobium in an amount by weight of 10.0 to about 15 times greater than carbon.

4. A precipitation-hardened stainless steel alloy according to claim 1, wherein the carbon content of the alloy is 0.03 to about 0.04 weight percent.

5. A precipitation-hardened stainless steel alloy according to claim 1, wherein the nitrogen content of the alloy is less than 0.020 weight percent.

6. A precipitation-hardened stainless steel alloy according to claim 1, wherein the grain size of the alloy is ASTM 7 or finer.

7. A precipitation-hardened stainless steel alloy according to claim 1, wherein the alloy is in the form of a steam turbine component.

8. A steam turbine component formed of a precipitation-hardened stainless steel alloy consisting of, by weight:

about 14.5 percent chromium;
about 6.5 percent nickel;
about 1.5 percent copper;
about 0.7 percent molybdenum;
0.03 to 0.4 percent carbon;
niobium in an amount by weight of 10.0 to about 15 times greater than carbon;
about 0.3 to about 0.8 percent manganese;
about 0.2 to about 0.5 percent silicon;
not greater than 0.05 percent vanadium;
not greater than 0.01 percent tin;
not greater than 0.030 percent nitrogen;
not greater than 0.015 percent phosphorus;
not greater than 0.020 percent aluminum;
not greater than 0.0002 percent sulfur;
not greater than 0.0001 percent silver;
not greater than 0.0001 percent lead;
the balance being essentially iron;
wherein the alloy has a grain size of ASTM 7 or finer, a delta ferrite content of less than 0.5 weight percent, an ultimate tensile strength of at least 1275 MPa, a Charpy impact toughness of at least 80 J, and is tempered at a temperature of about 480°C to about 500°C.

9. A steam turbine component according to claim 8, wherein the alloy has a Charpy impact toughness of 80 to about 110 J.

10. A method of processing a precipitation-hardened stainless steel alloy consisting essentially of, by weight:

14.0 to 16.0 percent chromium;
6.0 to 7.0 percent nickel;
1.25 to 1.75 percent copper;
0.5 to 1.0 percent molybdenum;
0.03 to 0.5 percent carbon;
niobium in an amount by weight of ten to twenty times greater than carbon;
not greater than 1.0 percent manganese;
not greater than 1.0 percent silicon;
not greater than 0.1 percent vanadium;
not greater than 0.1 percent tin;
not greater than 0.030 percent nitrogen;
not greater than 0.020 percent phosphorus;
not greater than 0.025 percent aluminum;
not greater than 0.008 percent sulfur;
not greater than 0.005 percent silver;
not greater than 0.005 percent lead; and
the balance being essentially iron;

the method comprising the steps of:

heat treating the alloy at a temperature of about 980°C to about 1100°C for a duration sufficient to form austenite; and

tempering the alloy at a temperature of about 480°C to about 525°C for at least four hours;

wherein as a result the alloy has a grain size of ASTM 5 or finer, a delta ferrite content of less than 0.5 weight percent, an ultimate tensile strength of at least 1200 MPa, and a Charpy impact toughness of greater

than 55 J.

11. A method according to claim 10, wherein the steel alloy has a Charpy impact toughness of at least 80 J.

12. A method according to claim 10, wherein the alloy contains niobium in an amount by weight of ten to fifteen times greater than carbon.

13. A method according to claim 10, wherein the carbon content of the alloy is 0.03 to about 0.04 weight percent.

14. A method according to claim 10, wherein the nitrogen content of the alloy is less than 0.020 weight percent.

15. A method according to claim 10, wherein the grain size of the alloy is ASTM 7 or finer.

16. A method according to claim 10, further comprising the step of forming the alloy to produce a steam turbine component.

17. A method of forming a steam turbine component of a precipitation-hardened stainless steel alloy consisting of, by weight:

about 14.5 percent chromium;
about 6.5 percent nickel;
about 1.5 percent copper;
about 0.7 percent molybdenum;
0.03 to 0.4 percent carbon;
niobium in an amount by weight of 10.0 to about 15 times greater than carbon;
about 0.3 to about 0.8 percent manganese;
about 0.2 to about 0.5 percent silicon;
not greater than 0.05 percent vanadium;
not greater than 0.01 percent tin;
not greater than 0.030 percent nitrogen;
not greater than 0.015 percent phosphorus;
not greater than 0.020 percent aluminum;
not greater than 0.0002 percent sulfur;
not greater than 0.0001 percent silver;
not greater than 0.0001 percent lead;
the balance being essentially iron;

the method comprising the steps of:

heat treating the alloy at a temperature of about 980°C to about 1100°C for a duration sufficient to form austenite; and

tempering the alloy at a temperature of about 480°C to about 500°C for at least four hours;

wherein as a result the alloy has a grain size of ASTM 7 or finer, a delta ferrite content of less than 0.5 weight percent, an ultimate tensile strength of at least 1275 MPa, and a Charpy impact toughness of at least

80 J.

18. A method according to claim 17, wherein the steel alloy has a Charpy impact toughness of 80 to about 110 J.